The Radiant Point of the April Meteors (Lyrids).

By W. F. Denning.

On Wednesday morning, 1803 April 20,* a brilliant meteoric shower was observed from Richmond, Va., Raleigh, N.C., Wilmington, Del., Schoharie County, N.Y., Portsmouth, N.H., and at several places in Massachusetts. The phenomenon was variously described according to the different impressions received by the observers. One said "the shooting stars were too numerous to be counted"; another stated that "the heavens seemed to be all on fire from the abundance of lucid meteors." The *Virginia Gazette* in alluding to the event said that "from one to three in the morning meteors seemed to fall from every point in the heavens, in such numbers as to resemble a shower of sky-rockets. The inhabitants happened at the same hour to be called from their houses by the fire bell, which was rung on account of a fire which broke out at the Armoury, so that everyone had an opportunity of witnessing this grand scene of Nature."

In 1838 April 20 Professor Wright and an assistant at Knoxville, Ten., counted 154 shooting stars between 10^h and 16^h. In 1839 April 18 Herrick watched for the return of the shower, and in the three hours following midnight he and another observer counted 58 meteors. Herrick placed the radiant at 273°+45° between *Lyra* and the head of *Draco*. In 1842 April 20 he re-observed the shower, and in spite of moonlight 151 meteors were seen by five observers between $10^h\ 20^m$ and 16^h. The maximum hourly rate was 55 between 15^h and 16^h, and the

* Ancient showers, probably of Lyrids, are mentioned by Biot, Chasles and Herrick. They have been summarised by Professor H. A. Newton in the *American Journal of Science and Art*, vol. xxxvi., p. 145, and he points out that the time of occurrence of the shower has advanced 24 hours in 60 years, owing to the precession of the equinoxes. The dates and corresponding modern epochs of the ancient displays are as follows:—

Authority.	Date.						
Biot	B.C. 687	March	16	equivalent to	A.D. 1850	April	19·9
Biot	„ 15	„	25	„	„	„	19·6
Chasles	A.D. 582	„	31	„	„	„	18·1
Chasles	„ 1093	April	9·6	„	„	„	20·7
Chasles	„ 1094	„	10	„	„	„	20·8
Herrick	„ 1095	„	9·6	„	„	„	20·2
Herrick	„ 1096	„	10	„	„	„	21·3
Herrick	„ 1122	„	10·6	„	„	„	20·2
Chasles	„ 1123	„	11	„	„	„	20·4
				Mean date . .	1850	April	20·1

The conformity of dates renders it extremely probable that the old observations refer to veritable returns of the Lyrids.

radiant point was thought to lie in *Corona Borealis*. The shower was again witnessed in 1849 April 19, when 54 meteors were counted in an hour by Herrick and two others. In 1850 April 20 an extraordinary display of meteors was witnessed at Bombay; and the shower which occurred in 1863, and was favourably seen in England, was judged to equal a moderately strong return of the *Perseids*, for meteors from the *Lyrid* radiant were falling at the rate of about 40 per hour.

Without, however, touching further upon the historical associations of the display it may be said that when in 1866 the April meteoric shower came to be associated with Thatcher's comet, 1861 I., the observed radiant point of the former did not correspond with the computed radiant for the comet to within 7 degrees. Later determinations were somewhat more satisfactory, and I found on closely watching the returns of the shower in 1878–79 and several subsequent years that the cometary and meteoric radiants were identical.

From my observations in 1885 I concluded that the *Lyrids* formed a radiant which, like the *Perseids* of August, moved eastwards amongst the stars from night to night. In 1887 my results supported those of 1885, but indicated a displacement less in extent, though the same in direction. But the evidence of the shifting of the radiant can hardly be regarded as demonstrated, for it is necessary in meteoric work of this kind to proceed with extreme caution, the research being surrounded with difficulties of no ordinary kind. During the present generation the shower of Lyrids has been comparatively feeble, and the display has been limited to very few nights, so that it is not feasible to gather a large number of observations, as may be done in the case of the Perseids.

Meteors are often singularly rare at this particular season of the year. After making allowance for time spent in registering paths the average horary rate of appearance for one observer, on the nights from April 18 to 22 inclusive, is only 8, including Lyrids; but if these are excluded, the rate is reduced to 5. This scarcity of meteors is not confined to this special epoch; it operates generally during the whole of the first half of the year. But though meteors are usually so rare, there is quite a swarm of feeble radiants contemporary with the Lyrids, and, selecting a few of the most prominent, they are at

$$202°+9°,\ 213°+53°,\ 217°-9°,\ 218°+33°,\ 228°-2°,\ 231°+17°,$$
$$252°-21°,\ 263°+62°,\ 272°+21°,\ 296°\pm0°,\ \text{and}\ 302°+23°.$$

Many others are visible, but the great feebleness of these streams is a bar to their general detection, unless the firmament is watched during the whole night, or, better still, throughout several successive nights. At this season an observer may sometimes watch a beautifully clear, moonless sky for an hour or more

without noticing a single shooting star, and may be led to suppose, from the stillness of the firmament, that not a single meteoric stream is in play; but if he perseveres in his observations during 15 or 20 hours on a few following nights a considerable number of minor radiants will gradually and accurately manifest themselves in various parts of the heavens.

A summary of my observations of the Lyrids during the epoch from April 16 to 26 1873–98 is given in the following table :—

Date, 1873–98.	Hours of Observation.	Total No. of meteors seen.	Lyrids.	Radiant Point.
April 16	3	14	3	$263^\circ + 33^\circ$
17	$4\frac{1}{2}$	21	...	...
18	$12\frac{1}{4}$	67	13	266 + 33
19	$18\frac{3}{4}$	123	45	268·6 + 32·3
20	19	141	62	272·4 + 32·8
21	15	88	20	272·5 + 33·5
22	$8\frac{1}{2}$	50	6	275 + 31
23	4	18	2	
24	1	5	...	
25	$7\frac{1}{4}$	31	...	
26	$4\frac{3}{4}$	19	...	
April 16–26	98	577	151	$271^\circ{\cdot}2 + 32^\circ{\cdot}9$ April 19–21.

The radiants from my own observations are :—

1885	April 18	...	$260^\circ + 33^\circ$*	1879	April 20	...	$272^\circ + 33^\circ$
1887	18	...	266 + 33	1885	20	...	274 + 33
1877	19	...	269 + 37†	1887	20	...	271 + 33
1884	19	...	269 + 33	1893	20	...	272 + 33
1885	19	...	268 + 33	1878	21	...	272 + 32
1887	19	...	269 + 31	1893	21	...	273 + 34
1878	20	...	273 + 32	1878	22	...	275 + 31

* Probably Herculids, and representing a stream quite distinct from the Lyrids.

† Certainly 4° N. of correct position. This radiant is omitted in deriving mean place in the previous table, and I have also quite disregarded the centre found at Bristol in 1873-4 when I had not acquired much practical experience in this line of work.

The radiants determined by other observers are:—

1839	Apr. 18	273° +45°*	58	Herrick.
1845–63	Apr. 19–20	282 +33	25	Greg.
1847–66	Apr. 15–31	277 +38	...	Heis.
1864	Apr. 19–20	277·5 +34·6	23	A. S. Herschel.
1851–68	Apr. 18–29	277 +34	12	Heis.
1867	Apr. 19–20	278·2 +34·5	16	Galle and Karlinski.
1869	Apr. 20	267 +35	7	Serpieri.
1871	Apr. 20	267 +35	17	A. S. Herschel.
1872	Apr. 19	275 +32	17	Lucas.
1874	Apr. 19–21	268 +33	7	Konkoly.
1877–78	Apr. 19–20	275 +35	24	Corder.
1879	Apr. 19	275 +37	13	Corder.
1879	Apr. 19–21	274 +34	10	Sawyer.
1882	Apr. 20	268 +37	26	Corder.
1893	Apr. 20–21	274·5 +40·5†	47	Nijland and Bolt.
1893	Apr. 20–21	270·5 +35 5	25	Corder.
1893	Apr. 20–21	270 +33	...	Ferrington.
1893	Apr. 20–21	271 +35·5	...	Blakeley.
1895	Apr. 19	274 +34	...	Corder.
1895	Apr. 19	269 +37	9	Blakeley.
1895	Apr. 21	274 +36	9	Blakeley.
1896	Apr. 10–22	275 +38	6	A. S. Herschel.
1898	Apr. 21–22	273 +33	12	Besley.
1898	Apr. 12–23	270 +40†	5	A. S. Herschel.
1898	Apr. 20	275·5 +31·5	22	Nijland.
1898	Apr. 21–24	276 +34	16	Nijland.

The mean of the 26 positions is 273°·3 +35°·6.

A large number of valuable observations were made at the epoch of the Lyrids between the years about 1865 and 1874, when the interest in this branch of astronomy had received a great impetus from the discovery of the identity of certain cometary and meteoric orbits. In Austria Professor E. Weiss collected two volumes of observations from 1867 to 1874, and among these were many of the April meteors, though they had never been reduced to their radiant points. The observers were

* Probably 12° N. of the correct position.

† These may represent showers of Draconids, as the radiants are far N. of that of the Lyrids.

Möller, Palisa, Wittek, Schulhof, Oppolzer, Littrow, Strasser, Sauter, Niessl, Holetschek, Karlinski, and others, and the chief places of observation were at Vienna, Kremsmünster, and O-Gyalla.

The Italian Meteoric Association, under the direction of Schiaparelli and Denza, also amassed many thousands of observations in different months, and Zezioli's and Heis's catalogues contain a great many more. The total number of meteors registered by these observers during the special epoch April 16 to 25, in the years from 1865 to 1874, was approximately as follows :—

Weiss's Austrian observations (1867–74)	1,468	meteors.
Italian Meteoric Association (1869–72)	997	,,
G. Zezioli at Bergamo (1867–70)	219	,,
E. Heis at Münster (1865–74)	152	,,
	2,836	,,

I carefully examined all these paths for the purpose of tracing the position of the radiant on succeeding nights, and my results were as follow :—

Date. 1865–74.	Radiant. α	δ	Area.	Lyrids.	Meteors observed.
	°	°	°		
Apr. 16	270	+31*	6	5	35
17	267	+29	6	6	94
18	268	+33	7	7	66
19	268	+30	10	70	294
20	271	+34	15	214	915
21	273	+31	10	79	482
22	273	+32	15	48	396
23	275	+33	7	47	379
24	...		...	2	54
25	275	+31	8	9	121
Apr. 16–25	271·1	+31·6	...	487	2,836

The series of positions greatly favours the idea of a moving radiant, and I think there can be no doubt of its occurrence, though the exact rate of the displacement is not quite certain. Before April 20, both my observations and reductions prove that the radiant is certainly W. of R.A. 270°, while on April 20 and following nights it is as certainly E. of it. I do not, however, attach much importance to radiant points derived from a large

* This position, as well as those for April 17, 18, and 25, are not based upon a sufficient number of paths to be reliable, and little weight should be attached to them.

collection of miscellaneous observations, some of which will be sure to be erroneous, either owing to comparative inexperience on the part of some observers or other causes. On projecting a large number of combined observations of this character upon an 18-inch globe it is usually found that they form very indefinite, scattered radiants extending over areas of 10°, 15°, or even more; and that the centres cannot be assigned with any approach to accuracy. In any doubtful question as to the visible behaviour of meteoric streams, it is not therefore advisable to appeal to such data as capable of affording a final settlement. The selected materials of one observer of known accuracy and experience would be of much greater value, but unfortunately no single individual can furnish the mass of observations desirable. To acquire this, we must necessarily collect materials from many sources; and these, though sufficiently full, are apt to induce doubts as to their accuracy and prove the inexpediency of fully trusting them.

In endeavouring to find whether motion occurs in a radiant, only such meteors should be utilised as are well observed and situated near their radiants. If observers set themselves to accumulate observations of this kind, we should in a few years have the means of disposing of some vexed questions in this branch of observational astronomy. In the case of a shower like the Lyrids, which is very feebly visible except on the night of maximum, it is not likely that photography will render us any efficient help in the immediate future, and so we must continue to look to ordinary eye observation to clear up any doubtful points associated with this system.

I have selected from amongst my observations at Bristol a number of Lyrids which were well seen, and moved chiefly in declination or were near the radiant. Such paths are obviously very important in endeavours to solve the question as to a change of position in the radiant:—

Date.	h m	Mag.	Path. From.	Path. To.	Length.
			° °	° °	°
1884 Apr. 19	11 24	1	271 + 36	271¾ + 36¾	1
1885 Apr. 19	12 19	4	266 + 37½	264 + 41	4
1885 Apr. 19	12 47	3	274½ + 39	278½ + 42½	4½
1887 Apr. 19	12 41	5	270½ + 15	271½ + 9	6
1887 Apr. 19	13 5	3	270 + 69	270¾ + 79¾	10¾
1887 Apr. 19	13 13	♀	269 + 11	269 + 1	10
1895 Apr. 19	11 58	4	278½ + 34	283½ + 35½	4
1873 Apr. 20	11 13	2	264½ + 16	261½ + 9	9
1874 Apr. 20	12 35	3	273 − 5	273 − 10	5
1874 Apr. 20	12 56	2	270 + 4	269 − 3	7
1878 Apr. 20	9 16	3	264 + 45	260 + 49	5
1878 Apr. 20	9 30	3	262 + 36	256 + 38	5½

Date.	h m	Mag.	Path. From.	Path. To.	Length.
			° °	° °	°
1885 Apr. 20	13 20	4	275½ + 27	275 + 23	4
1885 Apr. 20	13 46	4	265 + 53	262 + 58	5½
1885 Apr. 20	14 12	4	270 + 12½	269½ + 7	5½
1885 Apr. 20	14 24	4	261½ + 21	258 + 16¾	6
1885 Apr. 20	14 49	4	266 + 20½	263 + 16	5
1873 Apr. 21	10 22	3	273 + 51	273 + 61	10
1893 Apr. 21	12 8	4	270 + 44	268 + 49½	6
1893 Apr. 21	12 39	4	268 + 27¾	266½ + 25½	2½
1878 Apr. 22	10 50	5	265 + 61½	256 + 71	11
1894 Apr. 22	9 59	2	260 + 59	243 + 72	15

Bristol, 1899 February 20.

Nebulæ observed at the Royal Observatory, Cape of Good Hope, in 1898.

(*Communicated by David Gill, C.B., F.R.S., &c., H.M. Astronomer.*)

The following observations were made by Mr. R. T. A. Innes with the 7-inch Merz equatorial :—

No.	R.A. 1860. h	m	s	Dec. 1860. °	′	
1	3	27	44	−52	23	Equal to 10^{m}·5, round, 2′ diameter, near C.P.D.−52°, 414.
2	4	4	41	−45	53	Equal to 9^{m}·8, round, 10″ diameter, near C.P.D.−45°, 403.
3	4	14	8	−60	33	Equal to 9^{m}·8, round, 1′ diameter, brighter in middle.
4	5	39	0	−51	6	Equal to 9^{m}·7, round, 10″ diameter, brighter in middle.
5	14	12	5	−59	56	Faint, small, elongated.

The above are supposed to be new.

h 2629=G. C. 834 The position for 1860 is about $4^{h}\ 12^{m}\ 44^{s}$ −55° 56′, the place in the N.G.C. being wrong. It is quite close to C.Z. IV., 419, mag. 8·5, reddish, and is 13′ N. *p*.

h 2630=G.C. 838, which is a double nebula, the smaller component being N. *f*.

h 3443. *h* calls this a cluster. It now looks like an irregular nebula surrounding two stars.

H_{8}. V. 39. Not seen ; H_{8}. V. 40, which is near, and has exactly the same description, was well seen.

Royal Observatory, Cape of Good Hope:
1899 *January* 6.